

THREE NEW SPECIES OF INDO-WEST PACIFIC LIZARDFISH (SYNODONTIDAE)

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Abstract.—Three new species of *Synodus* (*S. doaki* n. sp., *S. jaculum* n. sp., and *S. rubromarmoratus* n. sp.) are described from the Indo-West Pacific. The 3 species are distinguished from the known Indo-West Pacific *Synodus* by the following combination of characters: *Synodus doaki* with no pigmented area at upper distal corner of operculum, 55–58 vertebrae, 11–12 peritoneal spots, 3½ scales above the lateral line, and anterior palatine teeth longest and forming a discrete group; *Synodus jaculum* with a patch of dense pigment at the base of the caudal fin, 5½ scales above the lateral line, 59–62 vertebrae, and the anterior palatine teeth longest and forming a discrete group; *Synodus rubromarmoratus* with no pigmented area at upper distal corner of operculum, anal-fin base shorter than dorsal-fin base, posterior pelvic process wide, 52–56 vertebrae, 12 peritoneal spots, and the anterior palatine teeth not longest and not forming a discrete group.

Recent collecting in eastern Australia–New Zealand by Russell and a comprehensive revision (to be published separately) of Indo-West Pacific *Synodus* by Cressey brought to light the 3 new species of lizardfish described here. These are among the 18 Indo-West Pacific species now considered valid (Cressey and Randall, in press; Cressey, m.s. in preparation).

Type material has been deposited in the following institutions: Australian Museum, Sydney (AMS); Bernice P. Bishop Museum, Honolulu (BPBM); National Museum of New Zealand, Wellington (NMNZ); U.S. National Museum of Natural History, Smithsonian Institution (USNM).

Measurements, counts and terminology used follow those of Schultz (1953: p xxi) and Hubbs and Lagler (1958: pp. 19–26). All measurements were made with vernier calipers to the nearest tenth millimeter. Measurements and counts for the holotype are given first. Those for the paratypes, where different from the holotype, appear in parentheses. The last dorsal- and anal-fin rays are split, connected at their base.

Synodus doaki, new species
(Fig. 1)

Synodus sp. Doak, 1972: p. 18, plates 6, 7, (Poor Knights Island, New Zealand).

Synodus sp. Allen et al., 1976: p. 380. (Lord Howe Island).

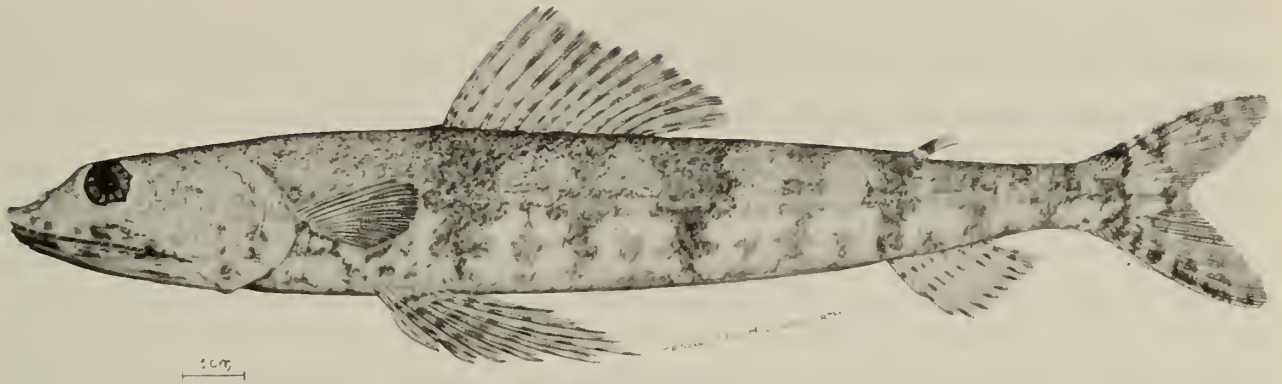


Fig. 1. *Synodus doaki* n. sp. Paratype NMNZ 6168, 171.4 mm SL, Poor Knights Island.

Holotype.—NMNZ 5676, 159 mm SL, Nursery Bay, Poor Knights Islands (35°30'S, 174°44'E), New Zealand, 19 m, B. C. Russell, 31 November 1970.

Paratypes.—NMNZ 5677, 96.5 mm SL, same data as holotype. NMNZ 5678, 140 mm SL, The Canyon, Poor Knights Islands, 30 m, A. M. Ayling, 17 June 1971. NMNZ 6168, 3, 178–209 mm SL, Nursery Cove, Poor Knights Islands, New Zealand, 19 m, B. C. Russell, 4 March 1975. AMS I.15338, 229 mm SL, Kingston, Norfolk Island (29°04'S, 167°57'E), 9 m, B. and L. Marsh, 4 March 1961. AMS I.18351-001, 85 mm SL, One Tree Island (23°30'S, 152°05'E), Great Barrier Reef, 30 m, B. C. Russell, 23 September, 1974. AMS I.18773-001, 92 mm SL, Phillip Island (29°07'S, 167°56'E), Norfolk Island, 15 m, B. C. Russell, 20 September 1975. BPBM 14655, 151.5 mm SL, Observatory Rock, Balls Pyramid (31°45'S, 159°14'E), Lord Howe Island, 31 m, B. C. Russell, 22 February 1973. BPBM 21057, 244 mm SL, Maro Reef (25°25'N, 170°35'W), Leeward Islands, Hawaii, 100 fms, *Townsend Cromwell Cr.* 77-02, D. Davis, 21 June 1977. USNM 218793, 2, 91–92.5 mm SL, coast of Kenya (2°42'S, 40°53'E), W. Indian Ocean, 140 m, *Anton Bruun Cruise* 8, Station 420A, 6 November 1964.

Diagnosis and comparisons.—A species of *Synodus* with the following combination of characters: dorsal-fin rays (branched and unbranched) 13–15 (usually 14); anal-fin rays 8–9 (usually 8); pored lateral-line scales 56–58 (usually 56); transverse scale rows 3½/7; vertebrae 55–58; combined dorsal and anal procurrent rays 31–35; anterior palatine teeth longest and in a discrete group; peritoneal spots 11–12; posterior pelvic process wide; no conspicuous spots on posterodorsal operculum.

This new species can be separated by its discrete group of long anterior palatine teeth from *Synodus indicus* (Day), *S. similis* McCullough, *S. kaianus* (Gunther), *S. macrops* Tanaka, *S. sageneus* (Waite), and *S. rubromarmoratus* n. sp., none of which has an anterior group of longer palatine teeth. The following species have higher vertebral counts than *S. doaki* (55–58): *S. capricornis* Cressey and Randall (64–65), *S. englemani* Schultz (59–62), *S. ulae* Schultz (62–65), and *S. jaculum* n. sp. (59–62). *Synodus fuscus*

Tanaka has a narrow posterior pelvic process. *Synodus variegatus* (Lacépède) has 5½ scales above the lateral line. *Synodus hoshinonis* Tanaka has conspicuous black pigment on the posterodorsal corner of the operculum. *Synodus binotatus* Schultz has lower vertebral counts (51–55) and fewer peritoneal spots (0–3).

Description.—Dorsal-fin rays ii, 12 (ii, 1-i, 14); anal-fin rays 9 (8–9); pectoral-fin rays 12 (12–13); pelvic-fin rays 8; procurrent rays 31–35, 17–19 dorsal, 14–16 ventral; lateral line continuous, 56 (56–58) pored scales; scale rows above lateral line from dorsal origin 3½; scale rows below lateral line to midventral line 7; predorsal scales 15 (14–17); vertebrae 55–58.

Proportions in standard length: greatest body depth 6.8 (5.7–8.0); head length 3.2 (3.0–3.7); snout length 13.8 (12.9–15.6); snout to dorsal origin 2.4 (2.3–2.5); dorsal origin to adipose origin 2.3 (2.2–2.5); length of dorsal-fin base 5.1 (4.7–6.1); length of anal-fin base 9.9 (10.0–11.6). Proportions in head length: snout length 4.3 (3.8–4.3); maxilla 1.7 (1.4–1.6); horizontal measurement of bony orbit 6.3 (4.3–6.3); least width of bony interorbital 11.1 (8.1–14.0); postorbital length of head 1.7 (1.6–1.9); longest dorsal ray 2.0 (1.8–2.5); length of pectoral fin 2.6 (2.2–2.8); length of pelvic fin 1.4 (0.9–1.5).

Body tubular, head somewhat depressed, caudal region a little compressed. Large cycloid scales on body, extending onto cheeks and operculum; 5–6 rows of cheek scales, post-oral portion of cheeks scaly. Snout sharply pointed, longer than broad; the anterior nostril on each side bearing a conspicuous leaflike flap on its posterior margin extending well beyond margin of nares when depressed anteriorly. Adipose eyelid narrow. Interorbital space concave, occipital region bony, weakly rugose above and behind eyes with 3 low bony ridges radiating from behind each eye, these more arborescent and distinct in larger specimens. A single row of forwardly directed teeth in each jaw and 1 or 2 rows of smaller teeth set below the level of lips. Palatine teeth in an elongate V-shaped pad, teeth pointing backwardly, those in front largest and in a discrete group. Lingual teeth well developed, those on free end of tongue largest and slightly recurved, in 5–6 rows, teeth of inner 1 or 2 rows smaller. Teeth in jaws, palatines, and tongue caniniform, larger teeth with arrow-shaped tips. Pectoral fins short, reaching a line from base of pelvic fins to origin of dorsal fin. Outer pelvic ray unbranched and short, the fifth branched ray (sixth ray) longest, reaching just beyond vertical from posterior base of dorsal fin. Posterior bony processes of pelvic girdle broad. Peritoneal color pale whitish, 11–12 small black spots along each side of body wall.

Color.—Fresh color as follows: Body pale with 8 undulated reddish bars extending from middorsal line almost to midventral line; the first and alternate bars paler. Three lengthwise reddish streaks along back and upper sides, one just below middorsal line, one between middorsal line and lateral

line, one just above lateral line. A series of reddish blotches along lower part of the sides between first and seventh vertical bars. Head reddish, cheeks and operculum pale, marbled with red. Lips broadly barred with red, a pair of red spots at tip of snout. Eye marked with red, pupil bright red. All fins marked with red transverse bands, adipose fin red, basal portion whitish.

An excellent color photograph of this fish is provided by Doak (1972: plate 6).

Colors are faded almost completely in alcohol.

Distribution and habitat.—Type specimens collected at the Poor Knights Islands in northern New Zealand, where they are locally common at depths of 19–30 m. Specimens collected at Norfolk Island, Lord Howe Island, and at One Tree Island, Great Barrier Reef were taken in water 9–35 m. The specimens from Hawaii and the Indian Ocean were trawled in depths greater than 140 m. *Synodus doaki* inhabits sandy bottoms close to rock or coral outcrops. In New Zealand they frequently were seen in pairs (Russell, pers. observation).

The present disparate distribution of this species (Hawaii, E. Australia—northern New Zealand, W. Indian Ocean) suggests a wide distribution, and additional collecting at intervening localities in deeper water undoubtedly will produce additional specimens.

Etymology.—Named *doaki* after Wade Doak, pioneer New Zealand diver and underwater naturalist, who first discovered this fish at the Poor Knights Islands.

Synodus jaculum, new species
(Fig. 2)

Holotype.—AMS I.19470-005, 62.5 mm SL, Granite Bluff, Lizard Island (14°40'S, 145°27'E), Great Barrier Reef, 16 m, B. C. Russell, 20 November 1975.

Paratypes.—AMS I.17262-053, 77.4 mm SL, Manubada Island (9°30'S, 147°05'E), Port Moresby, New Guinea, 1.5–3 m, B. Goldman, 24 June 1970. AMS I.17503-014 (2), 55–73.8 mm SL, Blanche Bay (4°18'S, 152°11'E), near Rabaul, New Britain, 4 m, G. R. Allen and J. E. Randall, 7 August 1973. AMS I.18303-001, 59 mm SL, off Clovelly Pool (33°55'S, 151°17'E), New South Wales, Australia, 12 m, R. Kuitert, 10 February 1975. AMS I.18340-001, 91 mm SL, One Tree Island (23°30'S, 152°05'E), Great Barrier Reef, 30 m, B. C. Russell, 15 September 1974. AMS I.18340-002 (2), 85.5–91 mm SL, One Tree Island, Great Barrier Reef, 33 m, B. C. Russell, 18 September 1974. AMS I.19222-001 (4), 65.3–78.5 mm SL, Sand Cay north of Lizard Island (14°39'S, 145°27'E), Great Barrier Reef, 21 m, B. C. Russell, 1 November 1974. AMS I.19473-054 (2), 59–82 mm SL, south end Coconut

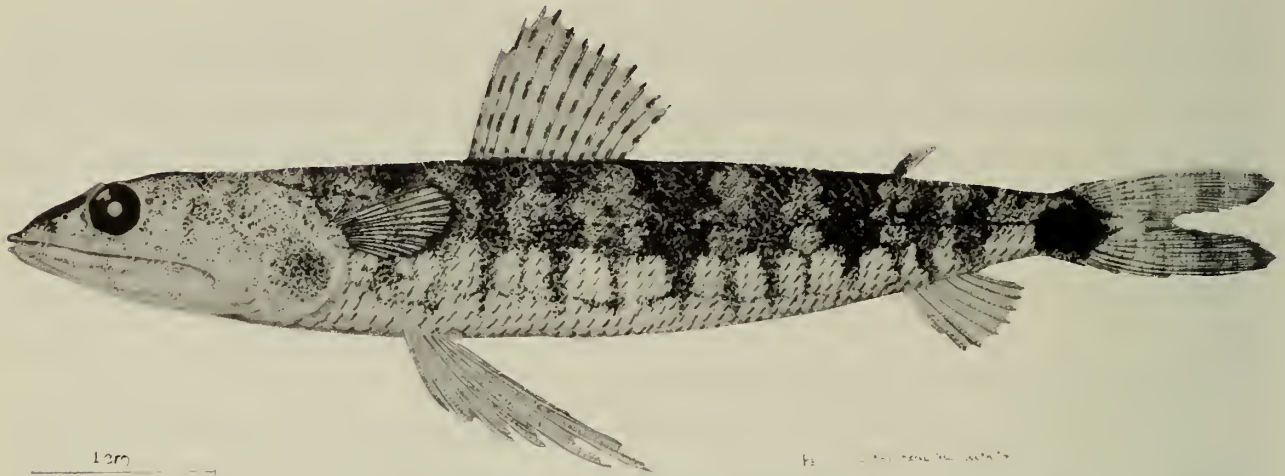


Fig. 2. *Synodus jaculum* n. sp. Paratype AMS I.18303-001, 59 mm SL, off Clovelly Pool, New South Wales, Australia.

Beach, Lizard Island (14°40'S, 145°27'E), Great Barrier Reef, 2–7 m, AMS party, 24 November 1975. AMS I.19696-004, 123 mm SL, South Solitary Island (30°13'S, 152°19'E), New South Wales, Australia, 20 m, B. C. Russell, 27 September 1976. USNM 217673, 103.5 mm SL, Pacific Macclesfield Bank (16°3.7'N, 114°43.5'E to 114°40'E), South China Sea 82–84 m, trawled "Cape St. Mary" cruise 3/64, W. L. Chan, 21 June 1964. USNM 217748, 93 mm SL, Pacific Macclesfield Bank (15°33.2'N, 113°56'E to 15°35.5'N, 113°54.5'E), South China Sea, 81–88 m, trawled "Cape St. Mary" cruise 3/64, W. L. Chan, 18 June 1964. USNM 217782, 91 mm SL, Pacific Macclesfield Bank (16°04.2'N, 114°41.8'E to 16°04'N, 114°39'E), South China Sea, 81 m, trawled "Cape St. Mary" cruise 3/64, W. L. Chan, 14 June 1964. USNM 217621 (2), 106–114.3 mm SL, Gulf of Manner (8°39'N, 79°37'E), Ceylon, 6–10 fms, T. Roberts, 3 April 1970. USNM 217640 82.8 mm SL, Comores Islands (12°53'S, 45°16'E), R. V. *Anton Bruun*, Cruise 9, 26 November 1964. USNM 217794, 79.1 mm SL, Christmas Island (1°56'N, 157°29'W), Line Islands, 3–4 m, R. Bolin, R. V. *Te Vega*, Cruise 8, 22 July 1965.

Diagnosis and comparisons.—A species of *Synodus* with the following combination of characters: dorsal-fin rays (branched and unbranched) 11–13 (usually 12); anal-fin rays 8–9 (usually 8); pored lateral-line scales 59–62 (usually 60); transverse scale rows 5½–6½/10–11; vertebrae 59–62 (usually 60); nasal flap small, short and triangular; anterior palatine teeth longest and in a discrete group; peritoneal spots 11–13; posterior pelvic process wide; base of caudal fin and peduncle black (colors in alcohol faded, but black on peduncle usually persists).

The conspicuous black pigment spot on the caudal peduncle of *S. jaculum* distinguishes it from all known species, but the preserved specimens from the South China Sea are much paler than the other material studied, and the black peduncular spot is not present. *Synodus jaculum* n. sp. can be

separated by its discrete anterior group of palatine teeth from *S. indicus*, *S. similis*, *S. kaianus*, *S. macrops*, *S. sageneus*, and *S. rubromarmoratus* in which the teeth are approximately equal in size and do not form a discrete group. It can be separated by its higher vertebral count (59–62) from *S. binotatus* (51–55), *S. fuscus* (53–56) and *S. hoshinonis* (54–56). It can be separated from *S. doaki* by its higher number of scales above the lateral line (5.5 vs. 3.5). It differs from *S. capricornis* by its lower vertebral count (59–62 vs. 64–65), from *S. ulae* by its smaller nose flap at the anterior nares and its generally lower vertebral count (59–62 vs. 62–65), from *S. englemani* by its higher peritoneal spot count (11–13 vs. 7–10), and from *S. variegatus* by its generally higher vertebral count of *jaculum* (59–62 vs. 55–60) and its short nose flap (long in *variegatus*).

Description.—Dorsal-fin rays ii, 10 (i, 10-ii, 10); anal-fin rays 8 (8–9); pectoral-fin rays 13 (12–13); pelvic fin rays 8; procurrent rays 28–33, 15–18 dorsal, 13–15 ventral; lateral line continuous, 60 (59–62) pored scales; scale rows above lateral line from dorsal origin $5\frac{1}{2}$ – $6\frac{1}{2}$; scales below lateral line to midventral line 10 (10–11); predorsal scales 20 (18–22); vertebrae 59–62.

Proportions in standard length: greatest body length 6.9 (5.7–8.1); head length 3.0 (2.9–3.5); snout length 13.9 (13.0–16.9); snout to dorsal origin 2.1 (2.3–2.5); dorsal origin to adipose origin 2.4 (2.3–2.5); length of dorsal-fin base 6.9 (5.6–7.6); length of anal-fin base 10.4 (11.2–18.5). Proportions in head length: snout length 4.7 (4.3–5.1); maxilla 1.4 (1.3–1.7); horizontal measurement of bony orbit 4.7 (4.7–6.0); least width of bony interorbital 8.4 (6.4–11.2); postorbital length of head 1.6 (1.5–1.7); longest dorsal ray 2.1 (1.8–2.8); length of pectoral fin 3.2 (2.6–3.7); length of pelvic fin 1.3 (1.3–1.6).

Body tubular, head somewhat depressed, caudal region a little compressed. Large cycloid scales on body, extending onto cheeks and operculum; 4–7 rows of cheek scales, post-oral portion of cheeks naked. Snout pointed, about as long as broad; anterior nostrils on each side bearing a short, triangular flap on its posterior margin, not extending beyond margin of nares when depressed anteriorly. Eye large, adipose eyelid narrow. Interorbital space concave, occipital region bony, smooth above and behind eyes with 3 bony ridges radiating from behind each eye. A single row of forwardly directed teeth in each jaw 1 or 2 rows of smaller teeth set below level of lips. Palatine teeth in an elongate V-shaped pad, teeth backwardly pointing, those in front largest and in a discrete group. Lingual teeth well developed, those on free end of tongue largest and slightly recurved, in 4–5 rows, inner 1 or 2 rows of teeth smaller. Teeth in jaws, palatines and tongue caniniform, larger teeth with arrow-shaped tips, particularly in bigger specimens. Pectoral fins short, just reaching to a line from base of pelvic fins to origin of dorsal fin. Outer pelvic ray unbranched and short, the fifth branched ray (sixth ray) longest, reaching to a line drawn vertically

from posterior base of dorsal fin. Posterior bony processes of pelvic girdle broad. Peritoneal color pale whitish with 11–13 black spots along each side of body wall.

Color.—(From color transparencies). Body mottled with red. Nine reddish undulated bars extending from middorsal line almost to midventral line, each bar broader on the dorsum, the second and every alternate bar lighter and narrower; bars edged with pale blue on dorsum, interspaces pink on dorsum, whitish on upper part of sides; lower part of sides with a reddish bar in interspaces and 2 pairs of white spots, these giving the appearance of 2 broken horizontal white lines along the lower part of the body. Ventral surface white. Base of caudal fin and peduncle black, axillary scales white. Head pinkish, cheeks and preopercle whitish, opercle mottled with red. Lips barred with white, 2 blackish streaks extending from anterior nostrils to tip of snout. Eyes reddish, pupils dark, edged with white. Dorsal fin with 3–4 faint transverse dark bands, other fins transparent.

Color in alcohol faded almost completely, but the dark mark on the peduncle and base of the caudal fin usually persists.

Distribution and geographic variation.—Specimens have been collected from Comores Islands, Ceylon, eastern Australia (New South Wales to the northern Great Barrier Reef), New Guinea, New Britain, South China Sea, and the Line Islands. This species occurs in shallow water as well as moderate depths (to 88 m) and is probably widespread throughout the Indo-West Pacific region. The higher number of transverse scales above the lateral line ($6\frac{1}{2}$) were on specimens at the periphery of its range, Comores and Christmas Island (Pacific).

Etymology.—Named *jaculum* (neuter noun in opposition) from the Latin word for javelin, in reference to the peculiar behavior of this species of launching itself off the bottom and swimming in midwater for prolonged periods.

Synodus rubromarmoratus, new species
(Fig. 3)

Holotype.—AMS I.19450-027, 75.9 mm SL, Mrs. Watson's Bay, Lizard Island ($14^{\circ}40'S$, $145^{\circ}27'E$), Great Barrier Reef, 15 m, AMS party, 10 November 1975.

Paratypes.—AMS I.19450-024 (10), 50.2–72.0 mm SL, same data as holotype. USNM 218792 (2), 70.3–71.2 mm SL, same data as holotype.

Diagnosis and comparisons.—A species of *Synodus* with the following combination of characters: dorsal-fin rays (branched and unbranched) 10–12 (usually 11); anal-fin rays 9; pored lateral-line scales 54–55 (usually 54); transverse scale rows $3\frac{1}{2}/6$; vertebrae 52–55; combined dorsal and ventral procurrent rays 24–29; anterior palatine teeth not longer than posterior and



Fig. 3. *Synodus rubromarmoratus* n. sp. Paratype USNM 218792, 71.2 mm SL, Mrs. Watson's Bay, Lizard Island, Great Barrier Reef.

not in a discrete group; peritoneal spots 12; peritoneum pale; anal-fin base shorter than dorsal-fin base; nose flap on anterior nares long and broad.

The anterior palatine teeth of *S. rubromarmoratus* are not longer than those that follow nor do they constitute a discrete group. This character separates them from the following species in which the anterior palatine teeth are longer and in a discrete group: *S. binotatus*, *S. capricornis*, *S. doaki*, *S. englemani*, *S. fuscus*, *S. hoshinonis*, *S. jaculum*, *S. ulae*, and *S. variegatus*. The new species can be separated by its pale peritoneum from *S. kaianus* and *S. macrops* (black in the latter 2 species). The lower vertebral count of *S. rubromarmoratus* (52–55) separates it from *S. similis* (58–58). In *S. sageneus* the base of the anal fin is longer than the base of its dorsal fin (shorter in *rubromarmoratus*). It can be separated from *S. indicus* by its long, broad, blunt-tipped, nose flap (flap of *indicus* is long but triangular and sharply pointed) and the higher number of peritoneal spots of (9–11 vs. 12 in *indicus*).

Description.—Dorsal-fin rays ii, 9 (ii, 8-ii, 10); anal-fin rays 9; pectoral-fin rays 12 (11–12); pelvic-fin rays 8; procurrent rays 24–29, 13–16 dorsal, 11–14 ventral; lateral line continuous, 54 (54–55) pored scales; scale rows above lateral line from dorsal origin $3\frac{1}{2}$; scale rows below lateral line to midventral line 6; predorsal scales 16 (14–16); vertebrae 54 (52–55).

Proportions in standard length: greatest body depth 7.1 (7.8–10.0); head length 3.7 (3.7–4.0); snout length 15.8 (15.6–19.6); snout to dorsal origin 2.3 (2.2–2.4); dorsal origin to adipose origin 2.5 (2.4–2.6); length of dorsal-fin base 8.0 (6.8–8.0); length of anal-fin base 10.0 (9.4–12.2). Proportions in head length: snout length 4.3 (4.1–4.9); maxilla 1.5 (1.3–1.6); horizontal measurement of bony orbit 4.3 (3.6–4.3); least width of bony interorbital 14.8 (11.0–17.5); postorbital length of head 1.7 (1.7–2.1); longest dorsal ray 1.9 (1.5–2.1); length of pectoral fin 2.4 (2.2–2.4); length of pelvic fin 1.3 (1.2–1.4); measured from tip of snout to rear edge of fleshy operculum.

Body tubular, head somewhat depressed, caudal region a little compressed. Large cycloid scales on body, extending onto cheeks and opercule; 5 rows of large cheek scales entirely covering cheeks. Snout pointed, broader than long; anterior nostrils on each side bearing a long leaflike flap on its posterior margin extending well beyond edge of nares when depressed anteriorly. Adipose eyelid narrow. Interorbital space very narrow and concave, occipital region bony, smooth, with 3 bony ridges radiating from behind each eye. A single row of forwardly directed teeth in each jaw and 1 or 2 rows of smaller teeth set below level of lips. Palatine teeth in an elongate V-shaped pad, in 2 rows, teeth backwardly pointing, those in front not longer than others. Lingual teeth large and slightly recurved, in 3 rows. Teeth in jaws, palatines and tongue caniniform, larger teeth with arrow-shaped tips. Pectoral fins short, not reaching to a line from base of pelvic fin to origin of dorsal fin. Outer pelvic ray unbranched and short, the fifth branched ray longest, reaching beyond a vertical from posterior base of the dorsal fin. Posterior bony processes of pelvic girdle short, broad. Peritoneal color pale, whitish with 11–12 black spots along each side of body wall.

Color.—(From color transparencies). Body mottled with red. Five broad undulated bars extend from middorsal line down to lower half of sides, dark reddish on dorsum, paling to reddish brown on sides. Interspaces mottled with pale reddish brown, a large brownish blotch separating 2 pairs of whitish spots in interspaces on lower part of sides, the spots forming a horizontal row along either side of body. Ventral region pale, whitish. Head reddish brown, cheeks and occipital region bright red. Eye reddish, pupil red, edged with yellow. Fins with 4–5 narrow indistinct transverse reddish bands, adipose fin red.

Colors in alcohol faded, head and dorsum mottled with grey, 8 greyish diamond-shaped markings on lower sides.

Distribution.—Thus far known only from the Great Barrier Reef, Australia. Type specimens were collected at Lizard Island in the northern part of the Barrier Reef, but this species also occurs in the southern part at One Tree Island (Russell, pers. observation) and is probably widespread throughout the region. Occurs in moderately deep water at depths of 15 m or greater.

Etymology.—Named *rubromarmoratus* (adjective) in reference to the characteristic red marbled coloration of the living fish.

Acknowledgments

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